SECTION 15

RIGGING

15.A GENERAL

15.A.01 Inspection and use.

a. Rigging equipment shall be inspected as specified by the manufacturer, by a Competent Person, before use on each shift and as necessary during its use to ensure that it is safe.

b. Defective rigging shall be removed from service.

c. The use and maintenance of rigging equipment shall be in accordance with recommendations of the rigging manufacturer and the equipment manufacturer. Rigging equipment shall not be loaded in excess of its recommended rated capacity.

d. Rigging equipment, when not in use, shall be removed from the immediate work area and properly stored and maintained in a safe condition.

15.A.02 Hoist rope shall not be wrapped around the load.

15.A.03 Running lines located within 6 ft - 6 in (1.9 m) of the ground or working level shall be guarded or the area restricted by physical barriers to preclude injury or injury from broken lines.

15.A.04 All eye splices shall be made in an approved manner. Rope thimbles of proper size shall be fitted in the eye, except that in slings the use of thimbles shall be optional.

15.A.05 When hoisting loads, a positive latching device shall be used to secure the load and rigging (i.e., self-closing safety latches,

hook with a spring-loaded gate, an alloy anchor type shackle with a bolt, nut and retaining pin). ***> See paragraph 15.H.07.c.***

15.A.06 Hooks, shackles, rings, pad eyes, and other fittings that show excessive wear or that have been bent, twisted, or otherwise damaged shall be removed from service.

15.A.07 Custom designed grabs, hooks, clamps, or other lifting accessories (i.e., equalizing beams, lifting or spreader beams, etc.) for such units as modular panels, prefabricated structures, and similar materials shall be marked to indicate the rated capacity and shall be proof-tested before initial use, to 125% of their rated load.

15.A.08 Structural and mechanical lifting devices shall be designed, tested and used in accordance with ASME B30.20, Below the Hook Lifting Devices.

15.B PERSONNEL QUALIFICATIONS

15.B.01 Any worker engaged in the duties and the performance of rigging shall be a Qualified Rigger and as such, shall meet the following requirements:

a. Be at least 18 years of age;

b. Be able to communicate effectively with the crane operator, the lift supervisor, signal person and affected personnel on site;

c. Have basic knowledge and understanding of equipment-operating characteristics, capabilities, and limitations and one whose competence in this skill has been demonstrated through training and experience satisfactory to management personnel. Prior to the specific activity or task, documentation of rigger qualifications shall be provided to the GDA. **> NOTE: The term "rigger" or "qualified rigger" in this manual refers to the function performed, and in no way relates to the worker's job classification or position.**

15.B.02 In addition, Qualified Riggers shall be able to demonstrate knowledge and proficiency to appropriate management personnel in the following;

a. Personnel roles and responsibilities;

b. Site preparation (terrain, environment);

c. Rigging equipment and materials;

d. Safe Hoisting Equipment operating procedures;

e. Principles of safe rigging;

f. Environmental hazards (overhead interferences);

g. Rigging and handling the load;

h. Identification of hoisting-related hazards;

i. The associated hazards when employee is required to be in the fall zone to handle a load.

15.C MULTIPLE LIFT RIGGING (MLR)

15.C.01 USACE allows multiple lift rigging practices for the purpose of erecting/placing structural steel ONLY. Strict compliance with this section and 1926.753 Subpart R shall be mandated.

15.C.02 A Multiple Lift **is considered a critical lift** and requires a carefully detailed, written critical lift plan per Section 16.H. In addition, all details and requirements of this section are required to be addressed in the Critical Lift Plan to include, as a minimum: identifying all multi-lift hazards on the job site, beam list; determining load capacity; determining weight of a member; proper crane hand signals; safety rules for Multi-lift rigging; seven- foot

rule; wind/environmental limits; safe route; power line issues; crane requirements; marking centerlines; use of tag line; qualifications and/or certifications of the operator(s) and rigger(s) to be performing these operations; rigging equipment: wire rope slings, hooks & shackles; clean lay-down area; cribbing; storage/staging; personal protective equipment.

15.C.03 A multiple lift may only be performed if the following criteria are met:

a. A MLR assembly is used*;*

b. A maximum of five members are hoisted per lift;

c. Only beams and similar structural members are lifted;

d. All employees engaged in MLR shall be trained in the following:

(1) The nature of the hazards associated with multiple lifts;

(2) The proper procedures and equipment to perform multiple lifts required in this section and as per 1926.753(e).

e. All loads shall be rigged by a qualified rigger per 15.B;

f. No crane is permitted to be used for a multiple lift where such use is contrary to the manufacturer’s specifications and limitations;

g. Components of the MLR assembly shall be specifically designed and assembled with a maximum capacity for total assembly and for each individual attachment point. This capacity, certified by the manufacturer or a qualified rigger, shall be based on the manufacturer’s specifications with a 5:1 safety factor for all components.

h. The total load shall not exceed:

(1) The rated capacity of the hoisting equipment specified in the hoisting equipment load charts;

(2) The rigging capacity specified in the rigging rating chart.

i. The MLR assembly shall be rigged with members:

(1) Attached at their center of gravity and maintained reasonably level;

(2) Rigged from the top down; and

(3) Rigged at least 7 feet (2.1 m) apart.

j. The members on the MLR assembly shall be set from the bottom up.

k. Controlled load lowering shall be used whenever the load is over the connectors.

15.D WIRE ROPE

15.D.01 Wire rope must be inspected, maintained and replaced per 16.D.12.

15.D.02 Wire rope removed from service due to defects shall be cut up or plainly marked as unfit for further use as rigging.

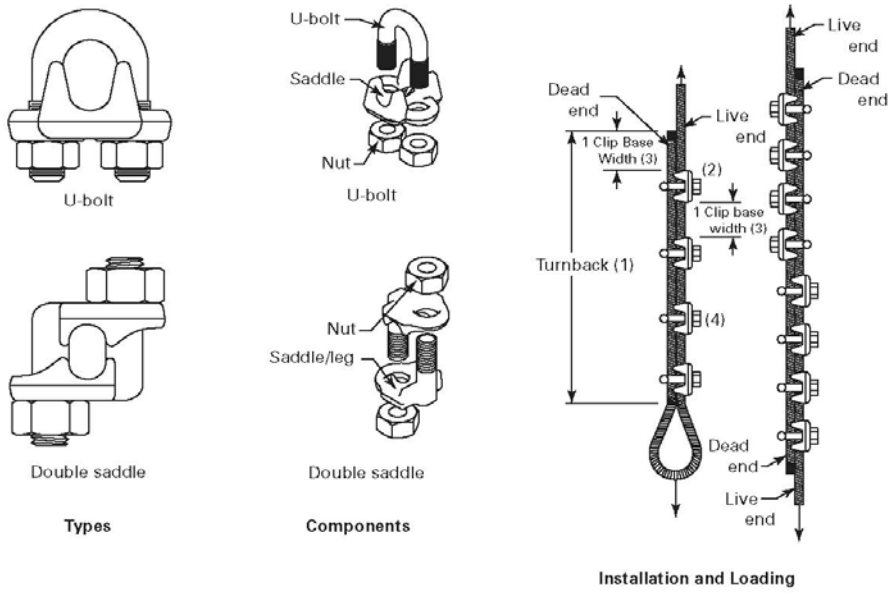
15.D.03 Wire rope clips attached with U-bolts shall have the U-bolts on the unloaded (dead) or short end of the rope. The clip nuts shall be retightened immediately after initial load carrying use and at periodic intervals thereafter. ***> See Figure 15-1.*** Use only wire rope clips made from forged steel of the single-saddle (U-bolt)

or double-saddle type clip. Do not use malleable cast-iron clips with wire ropes utilized for hosting. Refer to the clip manufacturer or a qualified person for spacing, number of clips and torque values.

15.D.04 When a wedge socket fastening is used, the unloaded (dead) or short end of the wire rope shall be looped back and secured to itself by a clip or have a separate piece of equal size wire rope attached with a clip or be properly secured to an extended wedge. The clip shall not be attached to the load (live) end. ***> See Figure 15-2.***

FIGURE 15-1

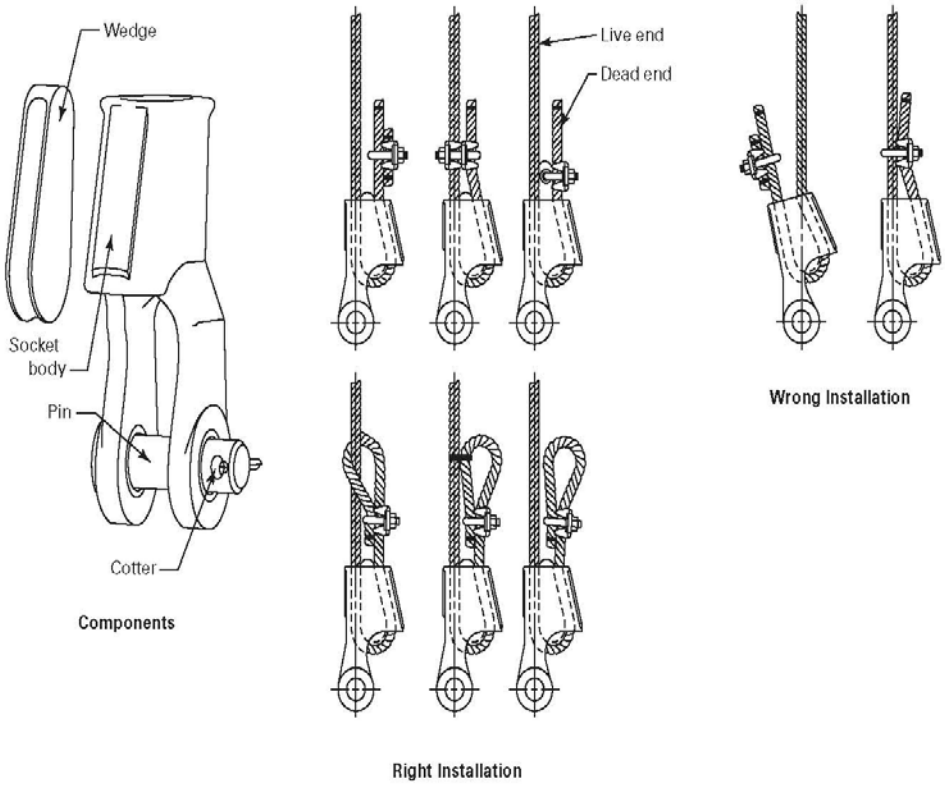
Wire Rope Clip Spacing



GENERAL NOTE: Correct number of clips for wire rope size shall be used.
NOTES:
(1) correct turnback length should be used
(2) correct orientation of saddle on live end shall be observed
(3) correct spacing of clips should be used
(4) correct torque on nuts shall be applied

FIGURE 15-2

Wire Rope Clip Orientation



15.D.05 Protruding ends of strands in splices on slings and bridles shall be covered or blunted.

15.D.06 Fabricated slings with eyes or endless loop slings using wire rope clips for hoisting material or lifting are prohibited except where the application precludes the use of prefabricated slings. All slings fabricated using wire rope clips shall be designed by a RPE for the specific application.

15.D.07 Except for eye splices in the ends of wires and for endless wire rope slings, wire rope used in hoisting, lowering, or pulling loads shall consist of one continuous piece without knot or splice.

a. An eye splice made in any wire rope shall have not less than five full tucks (this requirement shall not preclude the use of another form of splice or connection that can be shown to be as efficient and that is not otherwise prohibited).

b. Wire rope shall not be secured by knots except on haul back lines on scrapers.

15.D.08 Eyes in wire rope bridles, slings, or bull wires shall not be formed by wire rope clips or knots.

15.D.09 Wire rope clips shall not be used to splice rope.

15.E CHAIN

15.E.01 Only alloyed chain shall be used in rigging.

15.E.02 Chain shall be inspected before initial use and weekly thereafter. Inspect chains on an individual link basis. Chains shall be cleaned before they are inspected, as dirt and grease can hide nicks and cracks.

a. Wear: Replacement shall be as scheduled in Table 15-1.

b. Stretch: Compare the chain with its rated length or with a new length of chain. If the length is increased 3%, the chain must be thoroughly inspected. If the length is increased by 5% or more, the chain shall be replaced.

c. Deformed links: Deformed (twisted or bent) links, or any chain in which a link assembly does not hinge freely with the adjoining link.

d. Cuts, gouges, or nicks: If the depth of the cut or gouge exceeds the value shown in Table 15-1, the assembly shall be replaced.

e. Cracks: Cracks and other visible damage that causes doubt as to the strength of the chain.

TABLE 15-1

ALLOWABLE CHAIN WEAR

Nominal Chain Size	Maximum allowable wear of diameter
9/32 in (0.7 cm)	0.037 in (.09 cm)
3/8 in (0.9 cm)	0.052 in (.13 cm)
1/2 in (1.3 cm)	0.069 in (.18 cm)
5/8 in (1.5 cm)	0.084 in (.21 cm)
3/4 in (1.9 cm)	0.105 in (.27 cm)
7/8 in (2.1 cm)	0.116 in (.29 cm)
1 in (2.5 cm)	0.137 in (.35 cm)
1-1/4 in (3.1 cm)	0.169 in (.43 cm)

15.E.03 When used with alloy steel chains, hooks, rings, oblong links, pear-shaped links, welded or mechanical coupling links, or other attachments shall have a rated capacity at least equal to that of the chain.

15.E.04 Job or shop hooks and links, makeshift fasteners formed from bolts and rods, and other similar attachments shall not be used.

15.F SYNTHETIC ROPE SLINGS

15.F.01 Synthetic rope slings shall be inspected by a competent person for the following:

a. Broken or cut fibers, either internally or externally.

b. Cuts, gouges, abrasions; seriously or abnormally worn fibers.

c. Powdered fiber or particles of broken fiber inside the rope between the strands.

d. Variations in size or roundness of strands.

e. Discoloration or rotting; weakened or brittle fibers.

f. Excessive pitting or corrosion, or cracked, distorted, or broken fittings.

g. Kinks.

h. Melting or charring of the rope.

i. Other visible damage that causes doubt as to the strength of the rope.

15.F.02 Synthetic rope slings shall not be used if frozen. When using synthetic rope slings in chemically active or excessively hot environments, consult with the sling manufacturer or Qualified Person.

15.F.03 Synthetic rope slings shall be protected from abrasion by padding where it is fastened or drawn over square corners or sharp or rough surfaces.

15.F.04 All splices in synthetic rope slings provided by the employer shall be made in accordance with fiber rope manufacturer's recommendations.

15.F.05 Eye splices.

a. In manila rope, eye splices shall contain at least three full tucks and short splices shall contain at least six full tucks (three on each side of the centerline of the splice).

b. In layed synthetic fiber rope, eye splices shall contain at least four full tucks and short splices shall contain at least eight full tucks (four on each side of the centerline of the splice).

15.F.06 Strand end tails shall not be trimmed short (flush with the surface of the rope) immediately adjacent to the full tucks: this applies to both eye and short splices and all types of fiber rope.

a. For fiber ropes less than 1 in (2.5 cm) diameter, the tails shall project at least six rope diameters beyond the last full tuck.

b. For fiber ropes 1 in (2.5 cm) diameter and larger, the tails shall project at least 6 in (15.2 cm) beyond the last full tuck.

15.F.07 In applications where the projecting tails may be objectionable, the tails shall be tapered and spliced into the body of the rope using at least two additional tucks (which will require a tail

length of approximately six rope diameters beyond the last full tuck).

15.F.08 For all eye splices, the eye shall be sufficiently large to provide an included angle of not greater than 60° at the splice when the eye is placed over the load or support.

15.F.09 Knots shall not be used in lieu of splices.

15.G SLINGS. All slings shall be in accordance with ASME B30.9.

15.G.01 Slings and their fittings and fastenings, shall be inspected before use on each shift and as necessary during use.

a. Metal Mesh Slings shall be inspected for the following:

(1) Broken weld or brazed joint along the sling edge.

(2) Broken wire in any part of the mesh.

(3) Reduction in wire diameter of 25% due to abrasion or 15% due to corrosion.

(4) Lack of flexibility due to distortion of the mesh.

(5) Distortion of the choker fitting so that the depth of the slot is increased by more than 10%.

(6) Distortion of either end fitting so the width of the eye opening is decreased by more than 10%.

(7) A 15% reduction of the original cross-sectional area of metal at any point around the hook opening of end fitting.

(8) Excessive pitting or corrosion of fittings; broken or cracked fittings; distortion of either end fitting out of its plane.

(9) Other visible damage that causes doubt as to the strength of the sling.

b. Synthetic Webbing Slings shall be inspected for the following:

(1) Acid or caustic burns.

(2) Melting or charring of any part of the sling.

(3) Snags, holes, tears, or cuts.

(4) Broken or worn stitches.

(5) Excessive abrasive wear.

(6) Knots in any part of the sling.

(7) Wear or elongation exceeding the amount recommended by the manufacturer.

(8) Excessive pitting or corrosion, or cracked, distorted, or broken fittings.

(9) Other visible damage that causes doubt as to the strength of the sling.

15.G.02 Protection shall be provided between the sling and sharp unyielding surfaces of the load to be lifted.

15.G.03 The use of slings will be such that the entire load is positively secured.

15.G.04 Lengths.

a. Wire rope slings shall have a minimum length of clear wire rope equal to ten times the rope diameter between each end fitting or eye splice.

b. Braided slings shall have a minimum clear length of braided body equal to forty times the diameter of component ropes between each end fitting or eye splice.

15.G.05 Welded alloy steel chain slings shall have affixed durable permanent identification stating size, grade, rated capacity, and sling manufacturer.

15.G.06 Wire rope slings shall have affixed a durable permanent identification tag stating the diameter, rated load, lifting capacity in vertical, choker, basket configuration, and date placed in service.

15.G.07 The employer shall have each synthetic rope sling, metal mesh sling, synthetic web sling, or round sling marked or coded to show name or trademark of the manufacturer, rated capacities for the type of hitch, and type of material.

15.H RIGGING HARDWARE

15.H.01 Drums, sheaves, and pulleys shall be smooth and free of surface defects that may damage rigging. All rigging hardware shall be inspected for defects prior to use:

a. Hooks that have been opened more than 15% of the normal throat opening (measured at the narrowest point) or twisted more than 10% from the plane of the unbent hook.

b. Deformed master links and coupling links.

c. Assemblies with cracked hooks or other end fittings.

d. Excessive pitting or corrosion, or distorted or broken fittings.

e. Other visible damage that causes doubt as to the strength of the attachment.

15.H.02 The ratio between the diameter of the rigging and the drum, block, sheave, or pulley tread diameter shall be such that the rigging will adjust itself to the bend without excessive wear, deformation, or damage.

15.H.03 In no case will the safe diameters of drums, blocks, sheaves, or pulleys be reduced in replacement of such items unless compensating changes are made in terms of the rigging used and the safe loading limits.

15.H.04 Drums, sheaves, or pulleys having eccentric bores, cracked hubs, spokes, or flanges shall be removed from service.

15.H.05 Connections, fittings, fastenings, and attachments used with rigging shall be of good quality, of proper size and strength, and shall be installed in accordance with recommendations of the manufacturer.

15.H.06 Shackles. ***> See ASME B30.26.***

a. Only marked shackles (marked by manufacturer with name or trademark of manufacturer, rated load and size) shall be used. Shackles shall be maintained by the user so as to be legible throughout the life of the shackle.

b. Each new shackle pin shall be marked by manufacturer to show name or trademark of manufacturer and grade, material type or load rating.

c. Shackles shall be inspected visually by the user (or other designated person) prior to each use and periodically.

d. Repairs and/or modifications may only be as specified by the manufacturer or Qualified Person. Replacement parts, like pins, shall meet or exceed the original manufacturer's specifications.

e. Shackles shall not be eccentrically loaded (apply load to center of bow), shock loaded, nor shall they be loaded in excess of rated capacity.

f. Multiple sling legs shall not be applied to the shackle pin.

15.H.07 Hooks. ***> See ASME B30.10. See Figure 15-3.***

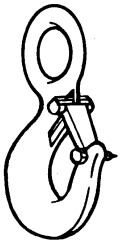
a. The manufacturer's recommendations shall be followed in determining the rated load of the various sizes and types of specific and identifiable hooks. Any hook for which the manufacturer's recommendations are not available shall be tested to twice the intended safe working load before it is put into use. The employer shall maintain a record of the dates and results of such tests.

b. Open hooks are prohibited in rigging used to hoist loads.

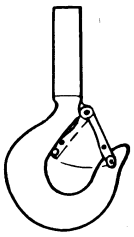
c. Miscellaneous-type hooks (i.e., grab hooks, foundry hooks, sorting hooks and choker hooks) may be used as long as they are used, inspected and maintained in accordance with Manufacturer's recommended use.

FIGURE 15-3

HOOKS



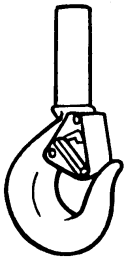
SELF-CLOSING TIPLOCK LATCH (EYE HOOK)



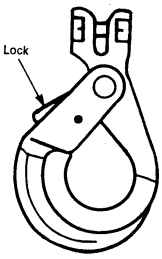
SELF-CLOSING TIPLOCK LATCH (SHANK HOOK)

SELF-CLOSING BAIL (EYE HOOK)

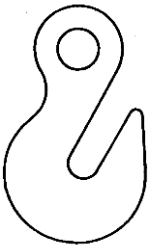
SELF-CLOSING FLAPPER LATCH LAMINATED PLATE HOOK



SELF-CLOSING FLAPPER LATCH (SHANK HOOK)



SELF-LOCKING CLEVIS HOOK (CLOSED)



EYE GRAB HOOK

15.H.08 Drums.

a. Drums shall have sufficient rope capacity with recommended rope size and reeving to perform all hoisting and lowering functions.

b. At least three full wraps (not layers) of rope shall remain on the drum at all times.

c. The drum end of the rope shall be anchored by a clamp securely attached to the drum with an arrangement approved by the manufacturer.

d. Grooved drums shall have the correct groove pitch for the diameter of the rope. The depth of the groove shall be correct for the diameter of the rope.

(1) The flanges on grooved drums shall project beyond the last layer of rope a distance of either 2 in (5 cm) or twice the diameter of the rope, whichever is greater.

(2) The flanges on ungrooved drums shall project beyond the last layer of rope a distance of either 2 1/2 in (6.3 cm) or twice the diameter of the rope, whichever is greater.

15.H.09 Sheaves.

a. Sheaves shall be compatible with the size of rope used, as specified by the manufacturer.

b. Sheaves shall be inspected to ensure they are of correct size, properly aligned, lubricated, and in good condition.

c. When rope is subject to riding or jumping off a sheave, the sheave shall be equipped with cable-keepers.

15.H.10 Eyebolts, Eye Nuts, Swivel Hoist Rings and Turnbuckles.

a. Use of this equipment shall be in accordance with ASME B30.26.

b. Rated load shall be in accordance with the manufacturer's recommendation.

c. Each turnbuckle, eye nut and eyebolt shall be marked with name or trademark of manufacturer, size or rated load and grade (for alloy eyebolts). In addition, each swivel hoist ring must also be marked to show torque value. Markings shall remain legible.

d. This equipment shall be inspected visually before each use by the user (or other designated person) and at least annually to determine condition is safe for use.

e. Turnbuckles shall not be side loaded and shall be rigged and secured to prevent unscrewing during the lift.

f. Shoulderless eye bolts shall not be loaded at an angle.